Claims:

1. An electronically controlled valve assembly, comprising:

a valve body having a valve seat, and at least one gas inlet and one gas outlet below the seat;

a piston movable within the valve body above the valve seat between an open position and a closed position, the piston being configured to seal the at least one gas inlet when the piston is moved to its closed position;

a solenoid coil for generating a magnetic field; and

a magnetic member, the magnetic member and the solenoid coil moving relatively away from each other when the solenoid coil is electromagnetically induced, such relative movement moving the piston between its open and closed positions.

2. The valve assembly of claim 1, wherein the gas outlet is in fluid communication with a substrate processing chamber.

3. The valve assembly of claim 2, wherein:

the position of the solenoid coil is fixed relative to the piston; and

the magnetic member mechanically acts against the piston to move the piston.

4. The valve assembly of claim 3, wherein the magnetic member is attached to the piston.

5. The valve assembly of claim 2, wherein:

the position of the solenoid coil is fixed relative to the piston; and

the magnetic member magnetically acts against the piston to move the piston.

6. The valve assembly of claim 2, wherein:

the position of the magnetic member is fixed relative to the piston; and

the solenoid coil mechanically acts against the piston to move the piston.

7. The valve assembly of claim 6, wherein the solenoid coil is attached to the piston.

8. The valve assembly of claim 2, wherein:

the position of the magnetic member is fixed relative to the piston; and

the solenoid coil magnetically acts against the piston to move the piston.

9. The valve assembly of claim 2, wherein the at least one gas inlet defines a reactant inlet and a purge gas inlet.

10. The valve assembly of claim 9, wherein the valve seat is configured to permit fluid communication between the purge gas inlet and the at least one outlet even when the piston is in its closed position.

11. The valve assembly of claim 2, wherein the piston comprises an elongated shaft, and a diaphragm at an end of the shaft for sealing against the at least one gas inlet when the piston is in its closed position.

12. The valve assembly of claim 11, wherein:

the piston further comprises an upper shaft, and a lower valve rod coupled to the upper shaft; and

the diaphragm is disposed at an end of the valve rod opposite the upper shaft.

13. The valve assembly of claim 11, wherein the diaphragm comprises:

an upper diaphragm member coupled to the shaft; and

a lower diaphragm member for sealing against the at least one gas inlet when the piston is in its closed position.

14. The valve assembly of claim 13, wherein the lower diaphragm has a thickness at least approximately 25% greater than a thickness of the upper diaphragm.

15. The valve assembly of claim 2, wherein the piston has a stroke length of about 0.2 mm.

16. The valve assembly of claim 2, wherein the valve seat is fabricated from a material selected from the group including PCTFE, PTFE, and combinations thereof.

17. The valve assembly of claim 12, further comprising a diaphragm position indicator.

18. The valve assembly of claim 2, wherein the solenoid coil is magnetically induced when it receives current through a control line.

19. The valve assembly of claim 2, wherein current is generated to the solenoid coil by a power driver.

20. The valve assembly of claim 19, wherein the power driver delivers current to the solenoid coil in response to signals from a programmable logic controller.

21. The valve assembly of claim 20, wherein the programmable logic controller is controlled by a main controller.

22. An electronically controlled valve assembly, comprising:

a valve body having a valve seat, and a reactant inlet and a gas outlet below the seat, the gas inlet being in fluid communication with a reactant source, and the gas outlet being in fluid communication with a substrate processing chamber;

a piston movable within the valve body above the valve seat between an open position and a closed position;

a diaphragm disposed at an end of the piston, the diaphragm being configured to seal the at least one gas inlet when the piston is moved to its closed position;

a biasing spring acting on the piston and connected diaphragm;

a solenoid coil for generating a magnetic field; and

a magnetic member, the magnetic member and the solenoid coil moving relatively away from each other when the solenoid coil is electromagnetically induced, such relative movement selectively moving the piston between its open and closed positions.

23. The valve assembly of claim 22, wherein the piston and connected diaphragm are biased by the spring in the closed position.

24. The valve assembly of claim 22, wherein:

the position of the solenoid coil is fixed relative to the piston; and

the magnetic member mechanically acts against the piston to move the piston.

25. The valve assembly of claim 22, wherein the piston and connected diaphragm are biased by the spring in the open position.

26. The valve assembly of claim 22, wherein the piston has a stroke length of about 0.2 mm.

27. A method of injecting a reactant into a substrate processing chamber, comprising the steps of:

placing a reactant gas source in fluid communication with an electronically controlled valve assembly, the valve assembly comprising:

a valve body having a valve seat, a reactant inlet and a gas outlet,

a piston movable within the valve body above the valve seat between an open position and a closed position, the piston being configured to seal the reactant inlet when the piston is moved to its closed position,

a solenoid coil for generating a magnetic field, and

a magnetic member, the magnetic member and the solenoid coil moving relatively away from each other when the solenoid coil is electromagnetically induced, such relative movement selectively moving the piston between its open and closed positions; and

directing a current to the solenoid coil to magnetically induce the coil, causing the piston to move relative to the valve seat.

28. The method of claim 27, wherein the step of directing a current to the solenoid coil causes the piston to move off of the valve seat, allowing reactant gas to move through the valve seat and the gas outlet.

29. The method of claim 27, wherein the step of directing a current to the solenoid coil causes the piston to move onto the valve seat, preventing reactant gas from flowing through the valve seat and the gas outlet.

30. The method of claim 27, further comprising the step of:

discontinuing the directing of current to the solenoid coil, causing the piston to seal against the valve seat, and preventing reactant gas from flowing through the valve seat and the gas outlet.

31. The method of claim 27, wherein:

the position of the solenoid coil is fixed relative to the valve body; and

the magnetic member mechanically acts against the piston to move the piston.

32. The method of claim 31, wherein the magnetic member is attached to the piston.

33. The method of claim 27, wherein:

the position of the solenoid coil is fixed relative to the valve body; and

the magnetic member magnetically acts against the piston to move the piston.

34. The method of claim 27, wherein:

the position of the magnetic member is fixed relative to the valve body; and

the solenoid coil mechanically acts against the piston to move the piston.

35. The method of claim 34, wherein the solenoid coil is attached to the piston.

36. The method of claim 27, wherein:

the position of the magnetic member is fixed relative to the valve body; and

the solenoid coil magnetically acts against the piston to move the piston.

37. The method of claim 27, wherein:

the piston further comprises an upper shaft, and a lower valve rod coupled to the upper shaft; and

the diaphragm is disposed at an end of the valve rod opposite the upper shaft.

38. The valve assembly of claim 37, wherein the diaphragm comprises:

an upper diaphragm member coupled to the shaft; and

a lower diaphragm member for sealing against the at least one gas inlet when the piston is in its closed position.

39. The valve assembly of claim 38, wherein the lower diaphragm has a thickness at least approximately 25% greater than a thickness of the upper diaphragm.

40. The valve assembly of claim 38, wherein the piston has a stroke length of about 0.2 mm.

41. The valve assembly of claim 38, wherein the valve seat is fabricated from a material selected from the group including PCTFE, PTFE, and combinations thereof.